DETECTING WATER IN THE MARTIAN SUBSURFACE

Jeffrey J. Plaut, Jet Propulsion Laboratory, California Institute of Technology, Mail Stop 183-501, 4800 Oak Grove Dr., Pasadena, CA 91109, plaut@jpl.nasa.gov.

A primary goal of the current program of Mars exploration is to determine distribution of water, both past and present. Geologic processes involving water are apparently responsible for many martian landforms. The history of water at the surface may be revealed through analysis of images and other remote sensing data of these landforms, as well as through in situ observations and experiments conducted by landed sensors. The present surficial distribution of water, which is most likely in the form of ice, can be also be determined by a combination of remote sensing and in situ observations. In 2004, the first observations targeted at detecting water in the subsurface will be obtained by the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS), flying onboard the European Space Agency's Mars Express orbiter. The main scientific objective of MARSIS is to detect, map and characterize subsurface interfaces in the upper few kilometers of the martian crust. In particular, a high-priority search will be made for boundaries between liquid-water-bearing and dry or ice-rich layers. Radar sounding is well-suited to this task because of the high contrast in dielectric constant between dry and moist materials. For terrestrial targets, airborne radar echo sounding is a key tool for probing ice sheets and glaciers. The large sub-ice-sheet Lake Vostok in Antarctica was originally identified using radar sounding. MARSIS will be targeting the icy polar deposits of Mars to search for sub-ice liquid zones, as well as more temperate regions for aquifer detection. Models of the interaction of the MARSIS radar signals with the expected martian crustal materials indicate that high dielectric contrast interfaces should be detectable down to depths as great as 5 km. If aquifers are present in the upper few kilometers, their detection by MARSIS is likely to revolutionize our understanding of the history and distribution of martian water.